VANN-Guard 70-Series

Power Management System
With Internal Electronic Monitor

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Introduction

Thank you for purchasing a Vanner *VANN-Guard Power Management System*. We are confident that you will be very pleased with its performance because our 70-Series are designed and manufactured by skilled professionals using the highest standards in workmanship. With minimum maintenance and care, you can be assured of many years of trouble free service.

General Description

The Vanner *VANN-Guard Power Management System* is an efficient and highly reliable method of obtaining a 12 volt DC power source from a 24 volt DC electrical system. The VANN-Guard makes the batteries look like they are in series and parallel at the same time. In addition to providing regulated 12 volt power, the system ensures that battery voltages remain equal which significantly extends battery life. Ideally suited for vehicle and alternate energy applications, the *VANN-Guard* is designed to save your batteries and the money you would spend replacing them. Users of the Vanner *VANN-Guard* know that it is the most cost effective and dependable solution for dual voltage systems.

The Internal Electronic Monitor is a device designed to monitor several critical functions in the electrical system. This unit provides fault signals that can be wired to warning lights, buzzers or other control/warning devices.

A typical system would include a 24VDC power source, such as an alternator or solar array, two 12 volt battery banks in series, and the *VANN-Guard*. The *VANN-Guard* connects to the 24 volt, 12 volt and ground terminals of the battery system. When the 12 volt loads require power, the *VANN-Guard* ensures that the current is taken equally from both batteries, and that the voltages of the two batteries are kept equal. This equalization ensures extended battery life and provides a stable 12 volt supply for operating accessories.

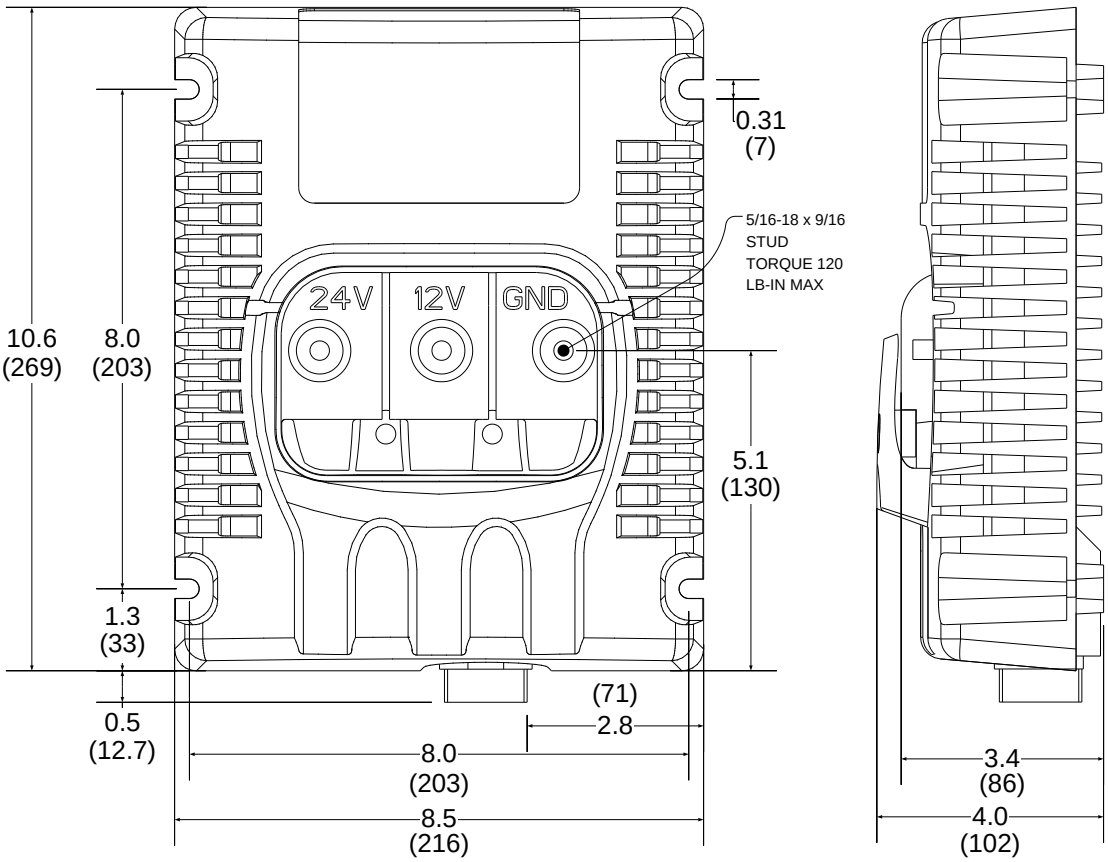
Paralleling VANN-Guard: Models are available which provide 60, 80 and 100 amps of 12 volt DC power. *VANN-Guard* may also be operated in parallel to provide more power. For example, two 60 amp units can be installed to provide 120 amps of 12 volt DC power.

NOTE: The Vanner *VANN-Guard Power Management System* is an extremely reliable device and, when installed according to the instructions, will provide reliable operation for an indefinite period of time. However, if a system abnormality should develop that would cause a *VANN-Guard* malfunction, damage to the battery system could result if 12 volt loads are present.

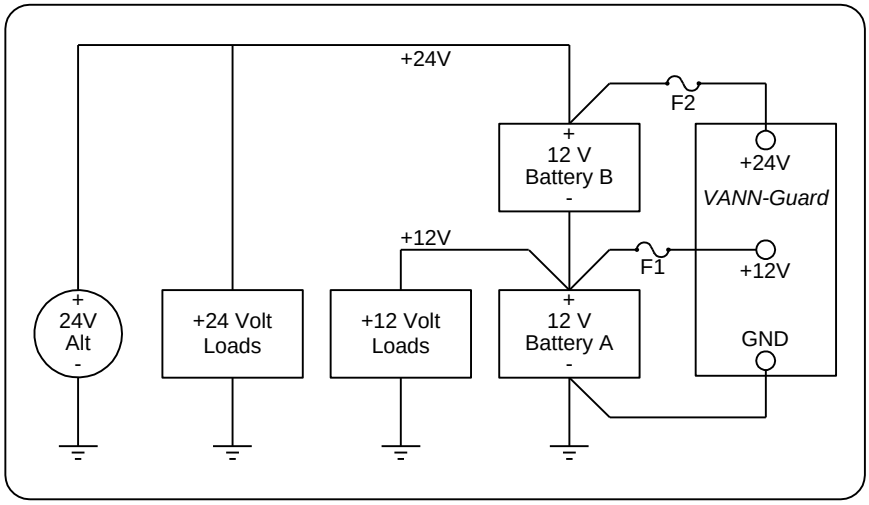
Specifications

70-Series Equalizers			
Model Number	70-60M	70-80M	70-100M
Input Voltage 24v	18 to 32 v		
Efficiency (Peak)	>97%	>97%	>97%
Max 24v Input Amps	32	43	53
Output Voltage	(Input Voltage/2) ±2%		
Output Amps (12v)	0-60	0-80	0-100
Standby Current	17 milliamps nominal at 28.4V		
Electronic Monitor	Alarm Low/High, Imbalance, Undervoltage protect override, Vann-Guard fault		
Operating Temp.	-40°C to +75°C (-40°F to 167°F)		
Storage Temp.	-54°C to +95°C (-65°F to 203°F)		
Serviceable	Yes	Yes	Yes
Environmental Considerations	Cast aluminum enclosure provides protection against salt, fungus, dust, water, fuel vapors and all fluids associated with commercial and off-highway vehicle operations. IP rated 56.		
Mounting Location	Mount on a flat surface close to the batteries to allow short cable runs. Location should be protected from battery acid and gases.		
Weights	8.7 lbs.	8.9 lbs.	9.3 lbs.

70M-Series Dimensional Specifications



Theory of Operation



In many 24 volt electrical systems it is desirable to tap into the battery system to obtain power for 12 volt loads. This method, while seemingly simple, causes a charge imbalance resulting in Battery B (see diagram) being overcharged, and possibly boiling, while Battery A discharges.

To solve this application problem the Vanner *VANN*-Guard is connected to the battery system at the +24 volt, +12 volt, and ground points. The *VANN-Guard* makes the batteries look like they are in series and in parallel at the same time. The *VANN-Guard* maintains the voltage balance and therefore the charge acceptance rate of each battery. The *VANN-Guard* hold Battery A and B voltages to within 0.05 volts under light loads and to within 0.1 volts at full rated load.

When the voltage of Battery A is higher than or equal to Battery B the *VANN-Guard* is in the standby mode, i.e., it is not transferring power from its 24 volt input to its 12 volt output. When a 12 volt load is present, and Battery A's voltage decreases to just below the voltage of Battery B, the *VANN-Guard* activates and transfers sufficient current from Battery B to Battery A to satisfy the load and maintain an equal voltage and charge in both batteries.

A key advantage of a system containing a Vanner *VANN-Guard*, compared to a DC to DC converter, is that if the 12 volt load requires a momentary surge current which exceeds the rated capacity of the *VANN-Guard*, Battery A will supply the extra current to the load. The *VANN-Guard* will then replenish the energy to Battery A after the surge has passed.

The following scenarios describe the *VANN-Guard Power Management System* operation.

Scenario #1 - 24 volt load present, no 12 volt load present. The system operates as a system would without the *VANN-Guard* whether the alternator is ON or OFF. The *VANN-Guard* is in the standby mode except for making small adjustments to keep the batteries in balance.

Scenario #2 - Both 24 volt and 12 volt loads present, alternator is OFF. The *VANN-Guard* will insure that both batteries will discharge at the same rate even if different loads are present.

Scenario # 3 - Both 24 volt and 12 volt loads present, alternator is ON. The alternator provides 24 volt power to the battery system and to the 24 volt loads. The *VANN-Guard* transfers power from the 24 volt source to the 12 volt load by converting 24 volt power to 12 volts. It will supply sufficient 12 volt power to satisfy the 12 volt load and to maintain battery voltage balance.

Monitor functionality

All functionality described in this section requires that the Monitor Ignition Input (Terminal B) be high in order to be active. All of the fault outputs have internal pull-ups to the +24v supply of 10K ohm.

A. Alarm Low Output
This output is pulled to ground if the 24V bus is below 24 volts, indicating an alternator or regulator failure.

B. Monitor Ignition (Enable) Input
This input enables the monitor function, when this pin is taken to +24V then the monitor becomes active. See below for more information.

C. Ground

D. Imbalance Alarm Output
This output is pulled low if the batteries are out of balance by more than 6%, this could indicate a 12V bus overload, a dead battery condition, or an Equalization failure.

E. Alarm High Output
This output is pulled low if the +24V bus is above 30 volts, indicating an alternator regulator failure.

F. Undervoltage Protection Override
If this pin is pulled high (more than 6V) the low voltage lockout on the lower battery is disabled, this is to allow jump starts with two wire jump, the added protection is then not available. See below for more information.
–Note: some Equalizers available in the market do not have undervoltage protection.

G. Equalizer Fault Output
This pin is pulled low when the Equalizer is faulty. See below for more information.

H. Equalizer Disable Input
This is a control pin for the Equalizer, if it is pulled low the Equalizer will be disabled. If it is left disconnected, or pulled high, the Equalizer will function normally.

J. Remote Sense Fault Output
If the compensation voltage (the total difference between the voltages at the equalizer and the voltages measured by the remote sense) exceeds 1.5v, the Remote Sense function is disabled and this pin is pulled low.

K. Unused

L. Unused

M. +24V Battery Remote Sense
If this pin is connected directly to the +24V battery positive by a separate line, it will improve the accuracy of the Equalizer balance of the batteries when load current is drawn. See below for more information.

N. +12V Battery Remote Sense
If this pin is connected directly to the +12V battery positive by a separate line, it will improve the accuracy of the Equalizer balance of the batteries when load current is drawn. See below for more information.

P. Battery Ground Remote Sense
If this pin is connected directly to the battery ground by a separate line, it will improve the accuracy of the Equalizer balance of the batteries when load current is drawn. See below for more information.

The monitor output from the unit is through a Deutsch brand connector P/N: HDP20-18-14PN. The mating connector is the Deutsch P/N: HDP26-18-14SN housing with Deutsch P/N: 1062-16-0622 socket contact.

Undervoltage Protection Override (Jump Start Override) (Terminal F)

This is an input, which overrides the low battery undervoltage lockout if the 24V bus is above 19VDC. The intent is to detect an attempted jump start so that the 12V bus can be powered in the event of a totally flat battery, and a 12V load present, with a two wire jump (12V battery does not have a jump connection, only the 24V and ground). If this line is allowed to float it will not be activated, to activate this feature this line should be tied to the 24V bus.

Equalizer Fault Output (Terminal G)

This is an indicator output with the same characteristics as the other monitor outputs, they can be wired together for a single warning, or discretely wired for more detailed information. This output is a pull down whenever an Equalizer fault is detected. There is logic in the monitor, which examines Equalizer behavior to decide if there is a fault. This is a significant improvement over previous indicators used in the industry, which simply show if the Equalizer is active. Those indicators give rise to false replacements if, for example, the batteries are balanced and the Equalizer stops running.

Equalizer Ignition Input (Terminal H)

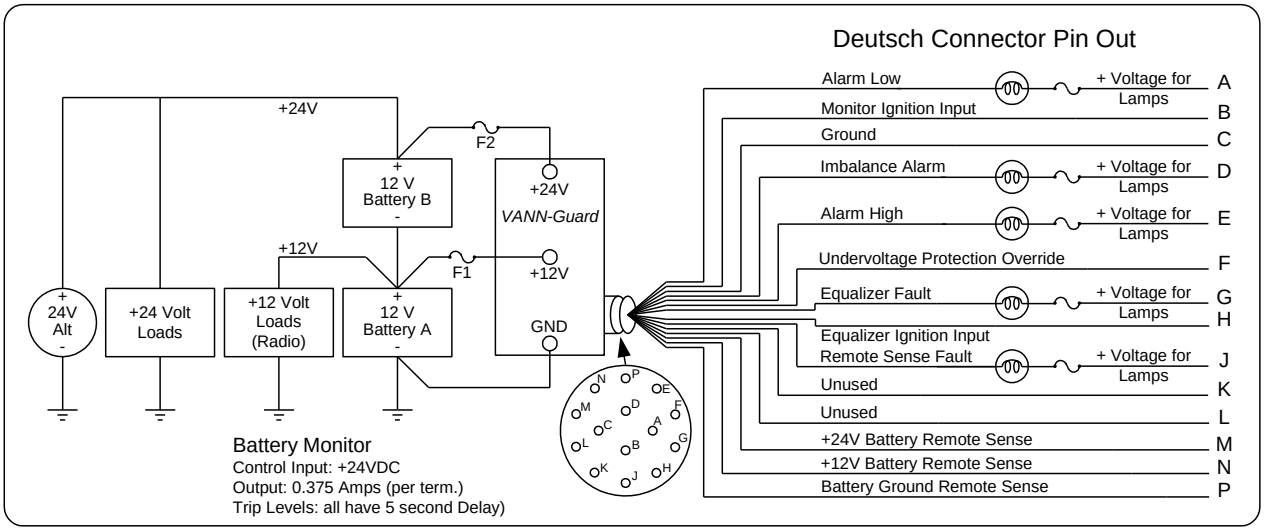
This input allows the Equalizer to be turned on and off by an external control signal, such as the ignition line. This line should be pulled low to turn off the unit, if it is left to float the Equalizer is enabled. If this line is tied to the ignition there will be enough additional load on the ignition line to perform the “pull down” function.

Remote Sense (Terminals M, N, and P)

Remote Sense allows remote sensing of battery voltage. This makes the Equalize function insensitive to voltage drops in the cables, fuses and connections. Remote Sense allows flexibility of configuration in the Equalizer power connection wiring and more freedom in Equalizer location.

When using Remote Sense the Equalizer DC power cables can be the minimum size listed in the Wire Size Table for a given Equalizer rating, up to four times the distance listed. This sets a maximum voltage drop of 0.4V which is reasonable from efficiency and fault detection considerations.

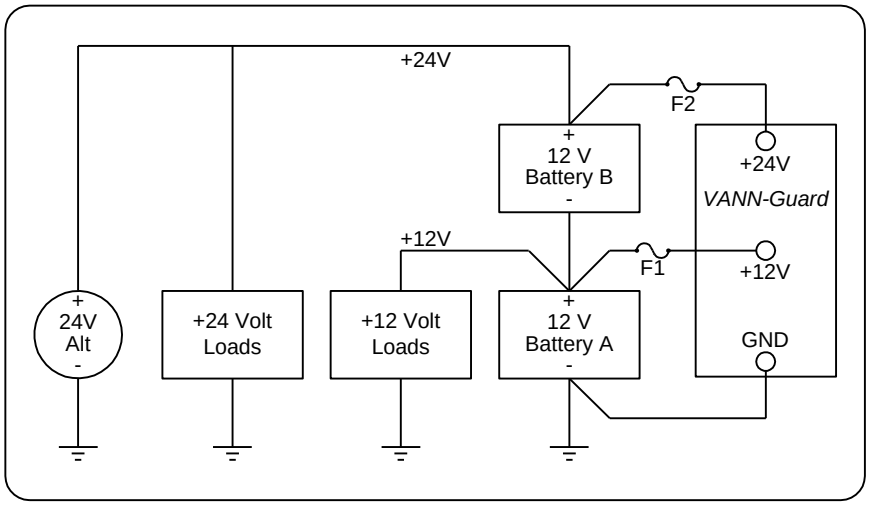
There are three inputs for the Remote Sense function, +24, +12, and Ground. The Remote Sense wires can be 16 or 18AWG as the input impedance is high. Select the wire gauge based on mechanical strength requirements. The Remote Sense wires each should have appropriately sized fuses for protection in case the wires become damaged or shorted. It may not be necessary to connect the Remote Sense wires directly to the battery. If the vehicle battery cables are brought to a distribution point from where connections are made to the rest of the vehicle, it is acceptable to connect the Remote Sense wires here. Sensing at the distribution point should not introduce a significant error since most of the time the battery cables are only carrying battery charging current. As the battery become charged and the charging current becomes minimal there will be almost no error.



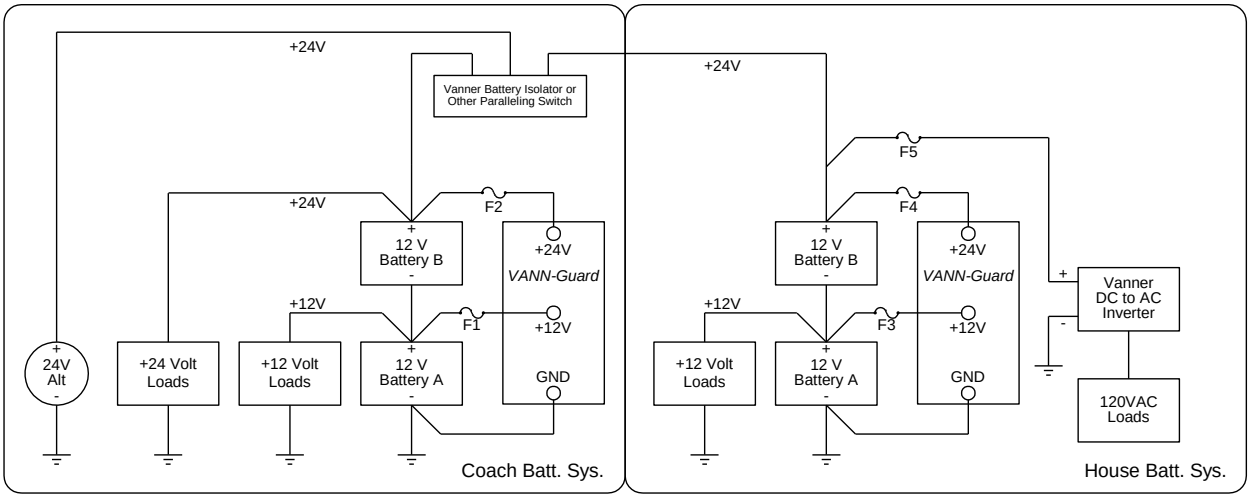
Typical Applications

Vanner *VANN-Guard Power Management Systems* are used in many types of applications including transit and tour buses, private coaches, heavy trucks and off highway equipment, yachts, and alternative energy systems such as solar powered homes. In addition to *VANN-Guards*, Vanner manufactures a wide range of complementary products such as DC to DC converters, DC to AC inverters, battery charger/conditioners, and battery isolators. The following system diagrams illustrate how these products are used in various applications.

TRANSIT BUS

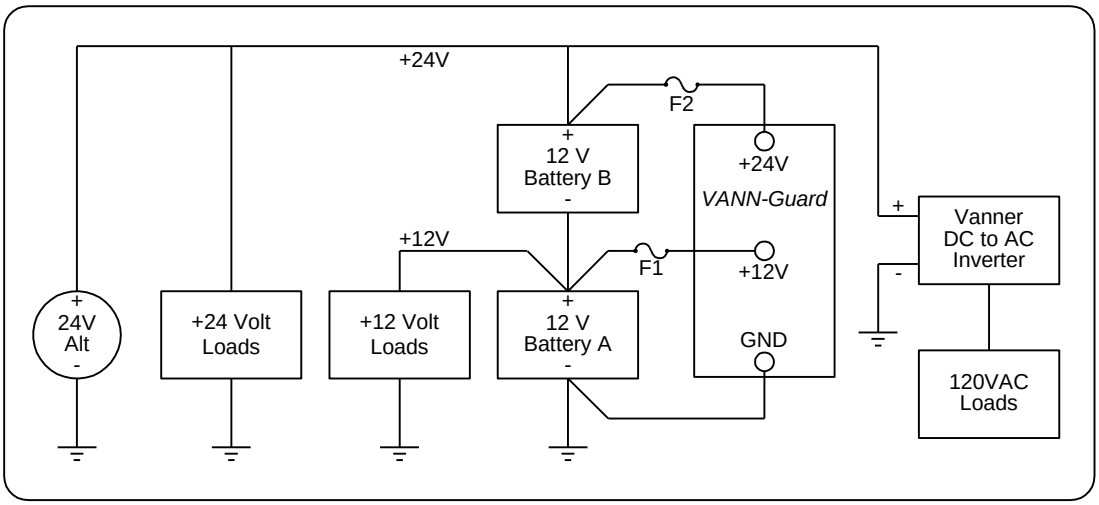


PRIVATE COACH

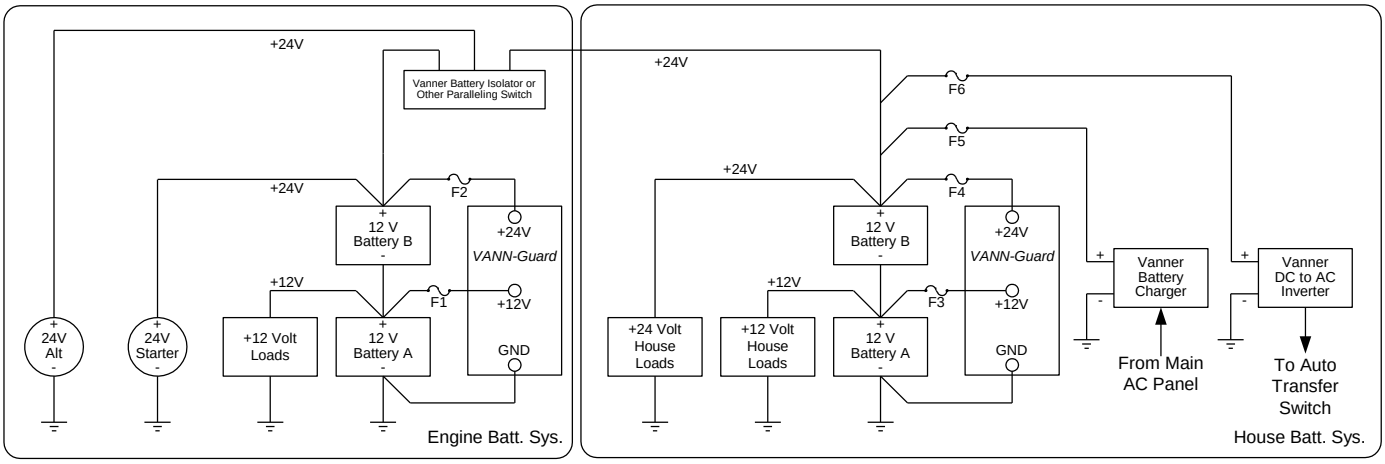


Applications Continued:

TOUR/CHARTER COACH



MARINE



Installation Instructions

Do not exceed the specified torque of 120 in-lbs. *when connecting cables to the terminal posts (+24, GND, +12) during installation of all the VANN-Guard Models. Torque values higher than specified may damage the product, reduce performance, and/or create hazardous conditions. Products damaged by improper torque are not covered by the warranty.*

Do not connect more than one conductor per terminal post on any Vanner VANN-Guard*. Multiple wires and cables may overstress internal components, resulting in poor performance or creating hazardous conditions. Products damaged by the installation of multiple conductors per post are not covered by the warranty.*

Fault protection devices must be installed between the VANN-Guard and the power source (battery*). A fault protection device would be any fuse or circuit breaker properly rated for the maximum DC current obtainable. This advisory is in accordance with SAE, NEC and UL, for mobile power applications. Install per applicable codes or within 18" of the battery. See Wire and Fuse Sizing Chart on page 10 of this manual or contact Vanner at 1-800-227-6937 or pwrsales@vanner.com if assistance is needed in sizing fault protection devices.*

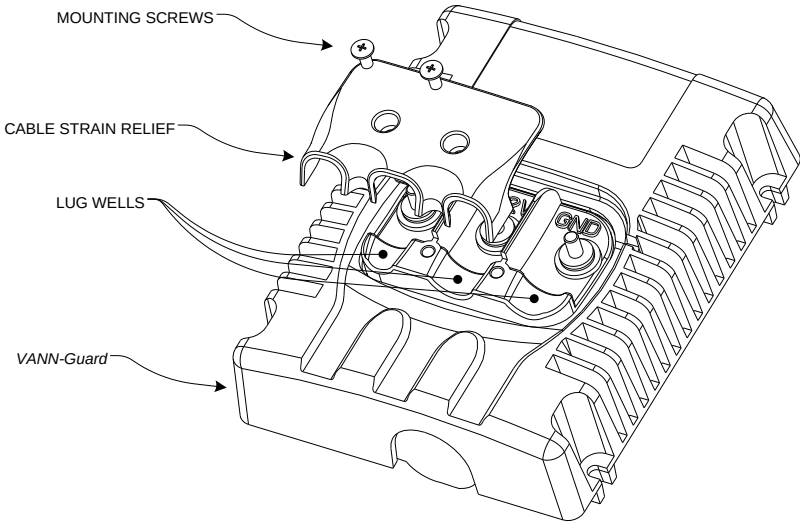
Caution: This equipment tends to produce arcs and sparks during installation. To prevent fire or explosion, compartments containing batteries or flammable materials must be properly ventilated. Safety goggles should always be worn when working near batteries

Mounting Location –The *VANN-Guard* may be mounted in any orientation, on a flat mounting surface suitable to support the *VANN-Guard* during application. Do not mount in zero-clearance compartment that may result in the *VANN-Guard* overheating. Locate so that contact by people is unlikely.

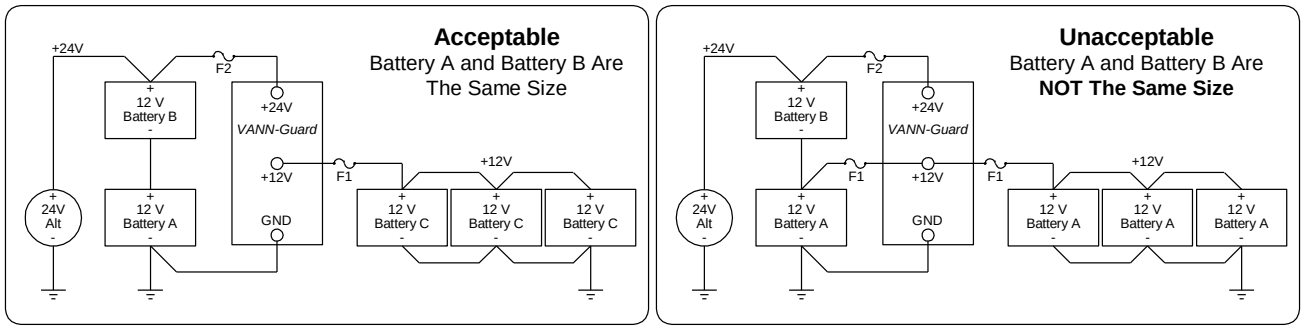
Environmental Protection – Your *VANN-Guard* has been designed to withstand direct exposure to rain and moisture. The *VANN-Guard* has also been tested for exposure to direct pressure spray, but continual exposure to direct pressure spraying may reduce the *VANN-Guard* serviceable life. Any damage due to water contamination is covered by Vanner only through the terms of our factory warranty.

Wiring Sequence– The *VANN-Guard* is internally protected for reverse polarity. The wiring sequence is not an issue with the *VANN-Guard* products.

Strain Relief – The *VANN-Guard* has an integral strain relief. The *VANN-Guard* is designed with wells for the lug to sit into to resist bolt loosening from cable movement, and the strain relief is designed to further inhibit cable movement. The diagram below shows the proper orientation for the attachment of the strain relief and the #10-32 mounting hardware that is supplied.



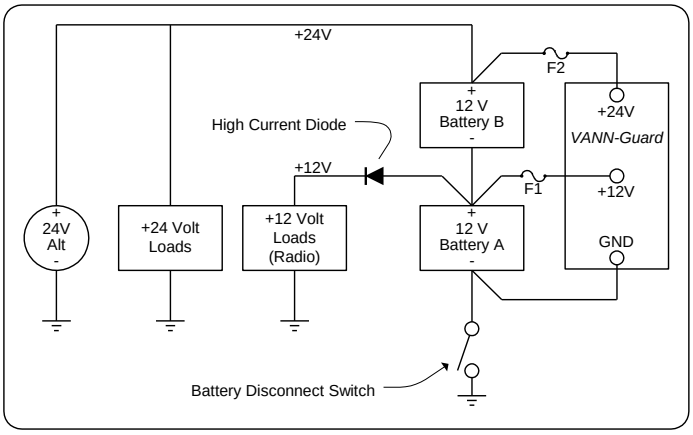
Caution adding 12volt batteries



In certain applications, such as private coach or alternate energy applications, it may be desirable to have additional 12 volt "House Batteries" to operate heavy 12 volt (inverter) loads. Use the *VANN-Guard* to charge the additional batteries.

Connect the *VANN-Guard* 12V terminal to the additional batteries only. Do not connect the *VANN-Guard* 12V terminal to both battery banks as this would make Battery A larger than Battery B. **Damage to Battery B may occur during charging** due to overcharging, if the VANN-Guard cannot keep up with the charging system.

Caution using a Ground-Side Battery Disconnect Switch



The system must be wired as shown to prevent Reverse Polarity Damage to polarity sensitive12 volt loads while the ground-side disconnect switch is open. The *VANN-Guards* GND terminal must be wired to the battery side of the ground-side disconnect switch circuit for the *VANN-Guard* to work properly.

Install the external High Current Diode, such as Vanner Model 52-75 (45 amp continuous rating) to protect polarity sensitive 12 volt loads if these loads do not already contain input diode protection. This prevents a reverse polarity on the 12 volt equipment when the battery switch is open. The reverse polarity does not come from the *VANN-Guard,* but from any 24 volt equipment that may be turned ON.

Wire Size and temperature rating

Cables connecting the *VANN-Guard* to the batteries must be sufficiently sized to prevent unwanted voltage drops. These voltage drops (loss) must be less than 0.05 VDC between the *VANN-Guard's* +24 volt terminal and the battery +24 volt terminal (Battery B positive terminal), less than 0.10 VDC between the *VANN-Guard's* +12 volt terminal and the battery +12 volt terminal (the jumper between Battery A and Battery B), and less than 0.05 VDC between the *VANN-Guard's* GND terminal and the battery ground terminal (Battery A negative terminal that is connected to chassis ground). In most installations, the *VANN-Guard's* terminals are wired directly to the battery terminals (reference fault protection) to prevent voltage loss that could occur in switch contacts, connections, and long wire runs. Since the *VANN-Guard* can be operated in temperatures up to 75ºC, use wire rated at least 90ºC. See Wire and Fuse Size Chart.

Wire and Fuse Size Chart

Wire Size AWG	Ring Terminal AMP or UL recognized equal	Max wire length, in feet, between *VANN-Guard* and battery to keep voltage drop under 0.1 volt. The chart assumes wire carries no other load and wire temperature is below 80ºC.			
		70-60M	70-80M	70-100M	2 X 70-100M
#8	33462	2.1	XXX	XXX	XXX
#6	33466	3.2	2.4	XXX	XXX
#4	33470	5.9	4.4	3.5	XXX
#2	322870	8.7	6.5	5.2	2.6
#1	321867	10.9	8.2	6.5	3.3
#1/0	321867	13.8	10.4	8.3	4.1
#2/0	321870	17.6	13.2	10.5	5.3
Fuse F1		80 amp	100 amp	125 amp	250 amp
Fuse F2		40 amp	50 amp	80 amp	150 amp

Crimp the ring terminals using ***AMP*** ROTA-CRIMP 600850 (2/0 - 8ga).
AMP Product Information Center: 800-522-6752
AMP Tooling Assistance Center: 800-722-1111

Note: The wire gages listed are for use without remote sense, see the monitor section for applications using the remote sense capability.

Testing and Troubleshooting

CAUTION
Servicing of electrical systems should only be performed by trained and qualified technical personnel.

Equipment Required

VoltMeter having 0.01 volt resolution. (Fluke Model 87 Multimeter recommended).
Clamp-on amp meter (Fluke Model 36 Clamp-on Meter recommended).

Vanner Repair Service

Vanner offers a quick turn around factory repair service. Send the unit to the address below with a note instructing us to repair it. Include your name, phone number, shipping address (not a P.O. Box Number), and your purchase order number.

Test Procedure for *VANN-Guard* 70-Series Power Management Systems

The VANN-Guard is working properly if:

1. The 12 volt DC loads are being operated continuously and are within the rated capacity of the VANN-Guard and;
2. Battery A voltage is lower than Battery B by no more than 0.05 to 0.10 volts (measured at the VANN-Guard's +24, +12 and GND terminals).

Vanner *VANN-Guards* are electronically protected against reverse polarity damage therefore the DC connection sequence is not an issue.

Vanner *VANN-Guards* will not function properly unless all three battery connections are made. Battery A and Battery B voltages both must be above 8 volts for the unit to turn ON.

Vanner *VANN-Guards* may be used in parallel with other *VANN-Guards* and Vanner Equalizer models.

Please note that the 24V, 12V and GND stud position and orientation are different on *VANN-Guard* 70-Series than on other Vanner Equalizers.

VANN-Guard Test Procedure:

1. Field-test the equalizer while fully connected to the vehicle batteries. For bench testing, two 12 volt batteries, or two 12 volt power supplies are required. The *VANN-Guard* must be connected to the batteries at GND, 12V and 24V to function properly.
2. If battery voltage is below 24 volts start the vehicle or apply a 24 volt battery charger to the batteries.
3. Turn ON 12 volt DC loads up to the *VANN-Guard's* rated capacity. Measure DC amps on the VANN-Guard +12 cable to verify load amperages.
4. **At the *VANN-Guard*** measure and record:
    a. Battery A voltage (voltage between the *VANN-Guard's* +12 and GND terminals)
    b. Battery B voltage (voltage between the *VANN-Guard's* +24 and +12 terminals)
5. Subtract Battery A voltage from Battery B voltage and compare readings.

Voltage Comparison		*VANN-Guard* Status	
a.	Battery A is lower than Battery B but within 0.05 volt.	OFF	Stand-by Mode. The *VANN-Guard* will not turn ON until Battery A is lower than Battery B by more than 0.05 volts.
b.	Battery A is lower than Battery B by 0.05 to 0.10 volts.	ON	Normal Operating Mode
c.	Battery A is lower than Battery B by more than 0.10 volts	ON	Self-Protection Mode due to Overload Condition. See below.
d.	Battery A is lower than Battery B by more than 0.10 volts	OFF	The *VANN-Guard* is not functioning properly.
e.	Battery A is higher than Battery B	Abnormal condition. Suspect Battery B is defective or a 12 volt load is connected to Battery B.	

Overload Condition

An overload condition exists when the 12 volt loads exceed the *VANN-Guard's* rated capacity. The overload condition will not damage the *VANN-Guard,* but may cause damage to the batteries.

During the overload, the *VANN-Guard's* output is limited by internal protection circuits to its Rated Output Amps. The 12 volt amps exceeding the *VANN-Guard's* output are drawn from Battery A which will begin to draw the batteries out of balance. The *VANN-Guard's* full Rated Output Amps are maintained as long as Battery A and Battery B remain balanced within 0.10 volt. The internal protection circuits will reduce the *VANN-Guard's* output as the batteries become further out-of-balance. If Battery A voltage falls below approximately 8 volts the *VANN-Guard* will shut itself OFF.

To correct the overload condition the 12 volt load must be reduced, or the *VANN-Guard's rated* capacity must be increased.

Trouble Shooting an Engine No-Start Situation

Situation:
A coach has dead batteries and won't start while jump starting. The coach is equipped with a 24 volt starting and charging system, a 12 volt electronic diesel engine control, a *VANN-Guard*, and a moderate 12 volt load which cannot be turned OFF. The coach sits for several days and the batteries run completely dead. During jump-starting the engine cranks but does not start due to low voltage on the 12 volt supply. Electrical testing reveals there is no 12 volt output from the *VANN-Guard* while jump starting even though the *VANN-Guard* separately tests OK.

Cause:
The 12 volt load which could not be turned OFF first ran both batteries down until the *VANN-Guard* shut itself OFF due to low voltage. (The *VANN-Guard* will shut OFF if system voltage falls below 16 volts or if voltage on either battery falls below 8 volts.) Then Battery A alone was drained to near zero volts.
As the bus is being jumped, 12 volt loads hold Battery A voltage too low for the *VANN-Guard* to turn ON and Battery A is too weak to support the 12 volt electronic engine control.

Solution:
Turn OFF all 12 volt loads (turning the battery disconnect switch OFF may accomplish this). Connect the jumper cables but do not crank the engine for two or three minutes. (Both batteries must rise above 8 volts.) The battery disconnect switch can then be turned ON and the bus should have adequate 12 volt power to start.

NOTES

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